NOAA SECTORAL APPLICATIONS RESEARCH PROGRAM (SARP)
PROJECT ANNUAL REPORT

PROJECT TITLE

Guidance Tools for Planning and Management of Urban Drainage Systems under a Changing Climate

INVESTIGATORS
(Research team and full contact information)
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NOAA GRANT NUMBER

NA07OAR4310373

PROJECT YEARS

SEPTEMBER 1, 2007 TO AUGUST 31, 2009

TIME PERIOD ADDRESSED BY REPORT *(e.g., August 2002-March 2003)*

09/01/2007 - 05/31/2008

I. PRELIMINARY MATERIALS

A. Project Abstract *(Limit to one page*

As the world urbanizes and more impervious surfaces are created, the challenges of managing urban drainage systems will increase. Drainage systems are used to manage "(excess surface) water (from extreme precipitation events) before it has reaches major stream channels" and, besides often leading to downstream flooding in major stream channels, drainage problems can create very expensive property damage, public health, hydrologic, and water quality problems. Costs of updating stormwater drainage systems in an urban area are high and cause major disruptions during construction. Urban water managers are under increased regulatory pressure to better manage urban stormwater. Present and future management of urban runoff is also made more complex by long-term anthropogenic climate change. The Intergovernmental Panel on Climate Change (IPCC) and other experts report that increased precipitation in extreme events in most regions of the world are expected under climate change.

Our objective is to investigate effective responses for urban water managers and policy makers to the challenges of drainage management in conditions of a changing climate and to start to build the capacity to respond. We will carry out the work on two

contrasting urban case studies in Massachusetts and Colorado where we will determine how the performance of a stormwater management system presently in the planning stage in the areas will change under climate change and adaptation strategies that explicitly consider the timing and sizing of investments in an uncertain future. We will conduct this research within a collaborative, participatory stakeholder process so that a variety of perspectives can be gained in the analysis and improve the likelihood of sustainable policies and solutions. We will begin the process with the active participation at each site of the managers in charge of storm water and a broad stakeholder assessment to start to uncover institutional obstacles to drainage adaptation. In the second year we will also hold one regional workshop of urban runoff managers and others in each region to disseminate our draft results and present them for review before they are finalized.

The end results of the research will be: 1) a set of guidelines applicable to many areas of the USA on planning for urban drainage management under conditions of a changing climate based upon the results of the research; 2) the framework for a decision-support tool to aid managers; 3) an analysis of institutional incentives and obstacles for drainage adaptation; 4) a website describing the project and results;5) presentations at conferences focused on this subject; and 6) articles in journals.

B. Objective of Research Project *(Limit to one paragraph*

Our objective is to investigate effective responses for urban water managers and policy makers to the challenges of drainage management in conditions of a changing climate and to start to build the capacity to respond. We will carry out the work on two contrasting urban case studies in Massachusetts and Colorado where we will determine how the performance of a stormwater management system presently in the planning stage in the areas will change under climate change and adaptation strategies that explicitly consider the timing and sizing of investments in an uncertain future. We will conduct this research within a collaborative, participatory stakeholder process so that a variety of perspectives can be gained in the analysis and improve the likelihood of sustainable policies and solutions. We will begin the process with the active participation at each site of the manager in charge of storm water and a broad stakeholder assessment to start to uncover institutional obstacles to drainage adaptation. In the second year we will also hold one regional workshop of urban runoff managers and others in each region to disseminate our draft results and present them for review before they are finalized

C. Approach (including methodological framework, models used, theory developed and tested, project monitoring and evaluation criteria) include a description of the key beneficiaries of the anticipated findings of this project (e.g., decision makers in a particular sector/level of government, researchers, private sector, science and resource management agencies) *(Limit to one page)*

YEAR 1

Task 1a. We will first review in detail the selected projects in both cities with the city engineers and other drainage managers. This will be reviewing data, design methods and tools, regulatory framework, and results to date. We will also review with them their needs, capacities, and institutional incentives and constraints in responding to the problems under both present and changing climate conditions. We will also set up a publicly available website for project to post project objectives, methodology, and results as they are obtained.

Task 1a. This is a new task added in Spring 2008. We will carry out a broad stakeholder assessment in at each site to uncover institutional obstacles to drainage adaptation and also start to build public support for adaptation. The assessment will include governmental officials, NGOs, citizens, researchers, and others.
Task 2. In this task we will develop ensembles of 3 hourly precipitation and temperature data for multiple stations within the basins of interest for the period 2005 to 2100 for each of the three greenhouse gas emission (GHG) scenarios used in Task 4.
Task 3. We will work with city engineers and other managers to develop two to three scenarios of land use change over time at the case study sites. We will also develop regulatory scenarios.
YEAR 1 and 2
Task 4. We will determine the expected net benefits of several design and construction sequences that a municipality might possibly follow over the next 95 years (2006-2100) assuming proper maintenance and replacement or updating of the project. The analysis will be done by using Monte Carlo simulation to determine the multidimensional costs of each design and construction sequence associated with each possible climate change, land use, and regulatory scenario combination that may occur in the future. We will also do sensitivity analysis to help answer the question of the value of waiting for better information that could be obtained by taking a temporary action until more is known about the climate in 2020.
YEAR 2
Task 5. We will review results of Task 4 with city officials and local partners and adjust analyses as necessary. We also hope to influence the design of the case study projects or later projects.
Task 6. Based upon the knowledge gained from the two case studies, we will prepare guidance document for urban stormwater managers on managing urban stormwater in changing climate conditions. The tools and approaches we used will be presented as a Decision Support Framework (DSF).
Task 7. We will hold New England Region and Colorado Front Range Region one-half or one day workshops on the research results. The purposes of the workshops are to share research results and to obtain feedback on the Guidance Document.
Task 8. We will revise the DSF and Guidance Document based upon the Workshops, post the final updates to the website, submit NOAA Final Report, submit journal articles, and more conference presentations.

Key Beneficiaries
These will include the municipalities of Somerville MA and Aurora CO and their residents, other units of government in the USA such as federal, state, and other municipalities, and the international research and policy communities interested in climate change adaptation.

D. Description of any matching funds/activities used in this project *(Limit to one paragraph)*

As described more in II.D, this project is now one of the inaugural projects of the Global Climate Change Collaborative (G3C). As part of this opportunity, we will have the research services of a graduate intern funded by the USGS for academic year 2008-2009.

II. ACCOMPLISHMENTS

A. Brief discussion of project timeline and tasks accomplished. Include a discussion of data collected, models developed or augmented, fieldwork undertaken, or analysis and/or evaluation undertaken, workshops held, training or other capacity building activities implemented. *(This can be submitted in bullet form – limit to two pages)*

Due to the late start of this grant, research has been limited. See Section II.D.

Task 1. Startup. We are meeting with the Aurora drainage managers on June 24, 2008 and in early July with the Somerville drainage managers. These meetings will result in detailed site selection, arrangements to collect technical data and plans for the institutional research and stakeholder assessment to start in Fall 2008.

Task 2. Downscaling. We are presently downscaling 3 hour precipitation data from 8 GCMs for 1990 to 2000, 2045 to 2050, and 2095 to 2100 for the different SRES scenarios ofA2, A1b, and B1 from the Lawrence Livermore National Laboratories website https://esgcet.llnl.gov:8443/index.jsp. Frequency analysis will be done to determine quantities in different design storms in the future and interpolations will be done to determine scenarios of continuous precipitation from the present to 2100.

B. Summary of findings, including their potential or actual implications for efforts to develop applications, methods, and science-based decision support capacity/systems and to foster sustainable resource management and vulnerability reduction. *(Limit to two pages, this builds on ersearch from previous time period)*

Based upon an initial literature review, we will be using a risk-based, robust decision making process to evaluate the technical procedures for adaptation planning. This means that for the results of an adaptation process, we will be determining: 1) how the design functions under a range of known and unknown risks, and 2) how acceptable risks and uncertainties are to stakeholders,

C. List of any reports, papers, publications or presentations arising from this project; please send any reprints of journal articles as they appear in the literature. Indicate whether a paper is formally reviewed and published. *(No text limit)*

None yet.

D. Discussion of any significant deviations from proposed workplan (e.g., shift in priorities following consultation with program manager, delayed fieldwork due to late arrival of funds, obstacles encountered during the course of the project that have impacted outcome delivery). *(Limit to one paragraph)*

Because of the late award of the grant (9/1/2007), the research team was not able to hire graduate research assistants to carry out much of the complex aspects of the tasks, which are actually starting in Summer 2008. The delay, however, was extremely beneficial because in the March 2008, the project was selected as one of the in inaugural projects of the Global Climate Change Collaborative (G3C). "G3C is a network of institutions around the world that conduct action

research projects to help communities, planners, and policy makers develop adaptive management and adaptive governance processes to prepare for the impacts of climate change". G3C was initiated by the U.S. Geological Survey and the Massachusetts Institute of Technology MUSIC program (MIT-USGS Science Impact Collaborative). MUSIC is one of the policy and applications research organizations of the USGS Global Change Science Program. Besides benefitting from the arranged collaboration with others doing adaptation research, the project will also have a funded intern from the MUSIC program working in the project. The initial tasks of the intern will be the stakeholder assessments in the two case study communities. In addition, an expert in agent based modeling (ABM) visiting the MUSIC program for academic year 2008-09 is considering using ABM to help stakeholders understand issues in adaptation planning and policy approaches. Therefore there is a significant added benefit to this project of the G3C collaboration.

The project will seek a no cost extension for one year next year.

E. Where appropriate, describe the climate information products and forecasts considered in your project (both NOAA and non-NOAA); identify any specific feedback on the NOAA products that might be helpful for improvement. (bulleted response)

- Historical meteorological data from NOAA
- Historical streamflow data from USGS
- GCM climate projections from multiple sources

III. GRAPHICS: PLEASE INCLUDE THE FOLLOWING GRAPHICS AS ATTACHMENTS TO YOUR REPORT

A. One Power point slide depicting the overall project framework/approach/results to date (included)
B. If appropriate, additional graphic(s) or presentation(s) depicting any key research results thus far (provided at completion)
C. Photographs (if easy to obtain) from fieldwork to depict study information (if applicable) (provided at completion).

IV. WEBSITE ADDRESS FOR FURTHER INFORMATION (IF APPLICABLE)

None yet.

V. ADDITIONAL RELEVANT INFORMATION NOT COVERED UNDER THE ABOVE CATEGORIES.

none